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## An Assessment of the Space Program

I welcome this opportunity to discuss the national space program of the Seventies in this forum at this time.

The subject is extremely timely. The question of America's future in space is very definitely on the American agenda right now, for decision in the next five or six months.

The question of what to do after Apollo has been the subject for careful study within NASA since 1965. At first this question was rather academic, but today it is both real and urgent. The Apollo program ends this year. Our only other presently approved program of manned space flight, the Skylab program, will be carried out and completed next year.

Unless we act decisively this year, the prospects for America's future in space, which could be very bright, will quickly fade away.

This brings us face to face with the issue of the Space Shuttle, the revolutionary new multi-purpose space vehicle which NASA sees as the keystone of the U. S. space program during this decade; which Congress has already approved on a tentative basis with a large bi-partisan majority; and which the President strongly supported in his statement from San Clemente on January 5.

The Shuttle decision is now up to Congress. Congress will again vote on the Shuttle during its consideration of NASA's budget request for Fiscal Year 1973, which begins July 1 of this year. I expect Congress to confirm last year's tentative go-ahead on the Shuttle. But before the vote I expect spirited debate on two main questions: Why do we need the Shuttle at this time? And what will it cost? This debate in Congress will be reflected in -- and influenced by -- discussion of the same questions throughout the country.

Committee hearings on our new budget are already under way in Washington. I testified before the Committee on Science and Astronautics of the House of Representatives earlier this week. In advocating the Space Shuttle I also want to point out that it is only a part of a realistic, well-balanced space effort for this decade. It is only a part of our overall effort to keep America strong and productive in space. But it is an essential part.

The United States cannot continue a worthwhile space program without the Shuttle. The Shuttle is the engine of our space program for the Seventies. It's an economy model, but it will keep America moving ahead in space. It will take you there and bring you back, as they used to say of the old Model T.

As President Nixon said in his statement of commitment to the Shuttle at San Clemente, this is a new means of transportation "designed to help transform the space frontier of the 1970s into familiar territory, easily accessible for human endeavor in the 1980s and 1990s."

The Space Shuttle, the President said, will "revolutionize transportation into near space by routinizing it"; it will give us "a real working presence in space." It will "broaden our opportunities for international cooperation in low-cost, multi-purpose space missions."

We can and must look upon the Space Shuttle as a major investment in America's future, as the key to American power and productivity in space for the rest of this century.

We can no longer be satisfied with occasional or exotic use of space. We cannot serve the national interest by just dabbling in space. We need the ability to use space routinely and cheaply and extensively for scientific research, practical benefits, and national security. And for this there is no rival, no substitute for the Shuttle. It is the logical next step forward. And the cost is moderate.

We estimate that a six-year development effort leading to the first manned flight in space in 1978 will cost a total of \$5.5 billion spread over these six years, with a peak cost of not much more than \$1 billion in any one year. So the development cost of the Shuttle will be about one fourth the cost of Apollo, with the promise of a much greater return on our investment in terms of practical benefits, space science, and national security.

I want to discuss the cost of the Shuttle development program in greater detail later on, because some people who should know better are using exaggerated and misleading figures which have no relation to the Shuttle program as we have defined it.

Perhaps at this point I should pause to tell you more precisely what the Shuttle is and what it will do. Then you may understand better why so much of America's future in space is indeed hitched to the Shuttle.

The Space Shuttle is much more than just a new vehicle. It is a whole new approach to space. It is not a follow-on to Apollo. It is not a follow-on to anything. It builds on present technology, but it is also a breakthrough that has to be made before the costs of using near-Earth space can be significantly reduced, and before this vast realm above the Earth can become a new home and workplace for Man.

The Space Shuttle will be our first reusable space vehicle. It will take off like a rocket, fly in orbit like a spaceship, and land like an airplane.

The Space Shuttle will have two stages: a Booster and an Orbiter. We already have a good idea what the Orbiter will look like, but competing concepts for the Booster are still being considered. A decision is expected shortly. The Orbiter will be about the size of a DC-9 airliner. It will be reusable except for its fuel tank, which will be jettisoned.

The two stages will be joined for a vertical take-off. When they have reached an altitude of say 40 miles, the Booster stage will drop away while the Orbiter stage continues into orbit on its own power. The Orbiter will be highly maneuverable in space and can remain there for as long as necessary to accomplish its mission. Normal missions are planned to last about a week, but if necessary the Orbiter can stay in space for up to 30 days.

When the Orbiter has completed its mission, its two-man crew will fly it back to Earth and land at a designated airport, just as any large airliner would. It will be refitted and fly again and again -- up to 100 times.

The Orbiter will have room in the crew compartment for two persons besides the two pilots. Provision can be made for up to 12 additional passengers in special modules carried in the pressurized payload bay.

The payload bay, or cargo compartment, will be about 15 feet in diameter and up to 60 feet long and will carry loads weighing up to 65,000 pounds. It can carry one very large payload into orbit or a number of smaller ones. Its crew can also pick up payloads from orbit and bring them back to Earth for repair or refurbishment. This is a valuable new capability that we need in order to use space economically. Thus the Shuttle can work productively on both legs of a trip into space. With the Shuttle, operational costs will be slashed dramatically.

The cost of each Shuttle flight will be about \$7.7 million. This will reduce the costs of putting a pound of payload into space from six or seven hundred dollars at present to about \$120 with a maximum load.

But the Shuttle will also make other savings possible. Through standardization, we can eliminate many of our present types of launch vehicles. One multipurpose vehicle will now be able to perform the missions that previously required a stable of rockets. More important, we can substantially reduce the cost of designing, building, and operating all kinds of satellites. Satellites will not have to be so restricted in size, shape, and weight. We can use more standard off-the-shelf components. The process of putting spacecraft together and testing them will be simplified. The time it takes to design a new payload for a specific mission may well be reduced from five or six years to five or six months. Moreover, some of the scientists and engineers who build payloads can accompany them into space to deploy them properly and repair them if necessary.

The men and women who will live and work in space in the Shuttle era need not be highly trained test pilots and astronauts. They will travel in shirtsleeve comfort in the pressurized passenger cabin.

How much money the Space Shuttle will save over the next few decades depends, of course, on how much we use it. Keep in mind that reducing the cost of launches and payloads will greatly expand the profitable uses that government agencies and commercial enterprises can make of space. Here we can take advantage of a productivity spiral in which lower costs generate more uses which further reduce costs, and so on.



Now that we have a green light from the President and have completed most of our preliminary studies, we expect to move promptly. This spring we plan to issue a request for proposals from contractors. This summer we will place the Shuttle under contract and development work will start. This work should give direct employment to 50,000 persons when it hits full stride. All major aerospace firms will be asked to submit proposals.

Now let us look more closely at some of the main issues in the Shuttle debate.

First, what will it really cost?

As I have said, the development costs over the next six years will be about \$5.5 billion. This includes two flight vehicles -- that is, two Orbiters and two Boosters.

New ground facilities for the Shuttle will cost about \$300 million.

Thus our total investment in the Shuttle, prior to routine operational use, will be less than \$6 billion.

A year ago, we were talking about a Shuttle that would cost \$10 or \$11 billion dollars to develop. But during the past year we have worked very hard on design changes to bring the development cost down. And we have succeeded dramatically -- cutting the estimated development cost by half without paying an unacceptable price in performance characteristics.

Our studies show that at the present level of space use -- less than 50 flights per year -- the Space Shuttle will save us about \$1 billion per year compared with the cost of using present-day launch vehicles. This means we can regain the cost of Shuttle development in five or six years of routine space operations during the 1980s.

These, then, are the important figures to keep in mind as the debate about the Shuttle program takes place: We can save \$1 billion a year at the present rate of space use and pay back Shuttle development costs within about six years.

But those are not the figures that some opponents of the Shuttle program use. First, they inflate development costs; second, they say that the number of launches per year must be greatly increased before there are any savings, which is not true; third, they incorrectly include the cost of payloads as part of the cost of the Shuttle. In this way, they reach the totally false conclusion that the Shuttle program will cost \$30 or \$40 billion over the next two decades.

Their figures are wrong, and their logic is wrong. It is against common sense to add the operational costs of the Shuttle to the development costs of the Shuttle. The cost of using the Shuttle to carry out a space mission should be added to the cost of the mission. Actually we will be saving money, not spending money, every time we use the Shuttle for a space mission.

So the figure we are debating about this year is not \$30 or \$40 billion as some Shuttle critics say, but about \$6 billion to be spent over the next six or seven years. When the Shuttle has been developed, the capital costs and the operating costs of the vehicles used will be charged to the mission for which they are used. We believe each Shuttle flight will cost only about \$7.7 million compared with about \$24 million for the Titan launch vehicle which can launch less than half as much payload.

Just remember, when an opponent of the Shuttle says that the launch rate per year must be greatly increased before the Shuttle makes sense, he is wrong. We can save \$1 billion a year by using the Shuttle at about the current launch rate, with less than 50 flights per year.

Another issue that crops up in the Shuttle debate is whether we are going to have enough payloads, enough space missions to make the Shuttle development effort worthwhile.

To answer any doubts on this score, I want to make this simple but very important point: The Shuttle is needed and will pay for itself simply as a replacement for the launch vehicles we are using now for most of our unmanned payloads.

One critic of the Shuttle said recently he was not opposed to the space program as such; he was merely opposed to the Shuttle and would gladly support an unmanned program costing \$2 to \$3 billion per year. He completely missed the point that it is a program of this sort that the Shuttle is designed to serve, saving money not only in launch costs but in the way the spacecraft are built, deployed, serviced and returned to Earth for refurbishment and reuse.

So keep in mind that we need the Shuttle first of all to get the most for our money out of a very modest effort to use unmanned satellites in Earth orbit for weather observations, communications, and Earth resources surveys. In fact, I believe the Shuttle will pay for itself simply as part of a space system designed to support efforts to protect and improve our environment.

Also keep in mind that the very existence of the Shuttle, its convenience and economy, could quickly lead to many additional uses for it. We should not forget that America was discovered by men who were looking for spices on the other side of the world, not for a new continent. I believe we would be very blind and very foolish if we do not anticipate much greater use of near-Earth space when the Shuttle becomes available at the end of this decade.

Let me mention just one example. Attention is already being given to the possible large-scale use of solar power collected in space and transmitted to Earth by microwave. On Earth this solar energy would be converted to electrical power and fed into the Nation's power grids. The technology to make such a system economical is not yet in hand, but the idea merits investigation.

There is another issue in the Shuttle debate that I would like to clarify. The Shuttle is not primarily a manned space flight project. In fact, about 80 percent of its payloads for the foreseeable future will probably be unmanned spacecraft. So we need the Shuttle to cut the costs and increase the return from our unmanned spacecraft. In addition, one of the most convincing reasons for investing in the Space Shuttle is that it does maintain and increase America's ability to use men in space.

The payload bay of the Shuttle can be outfitted as an astronomical observatory, an industrial laboratory, or an Earth observation station where scientists and technicians can work for periods up to seven days or more. The Skylab flights next year will give us a better idea of what men can do in space that machines and instruments alone cannot do. I am already firmly convinced that man has important missions to perform in space, and the Shuttle is the economical way to get him there and back. Eventually, although not in this decade, we will find the Shuttle an essential transporter for erecting and maintaining large manned space stations.

The fact that the Shuttle guarantees the continued presence of Americans in space is a powerful argument for it, not against it.

Suppose, for a moment, we followed the critics' advice, and decided this year not to build the Shuttle. What harm would that do?

- To begin with, our space program would be handicapped by outmoded technology and high costs. Expansion of present uses of space and discovery of new uses would be discouraged.
- Second, this country would be without any future plans for using men in space. Apollo ends this year, and the Skylab program ends next year. The Russians, on the other hand, are planning for very active use of men in space in this decade.

-- Third, we would be turning down the opportunity for very fruitful cooperation with other countries which the Shuttle offers.

-- Fourth, we would be turning our backs to this new frontier and handing over to the Soviet Union a virtual monopoly to operate in this promising new field of human endeavor.

To put it briefly, the U. S. space program without the Shuttle would quickly become a dead-end program and near-Earth space a place of peril instead of promise. Is this what we want in order to save (quote unquote) \$1 billion a year in this decade? I don't think so.

It's far far better to invest the billion per year in the Shuttle now than tens of billions per year in another catch-up race later on.

We can easily afford to build the Shuttle. We can't afford not to.

I am well pleased with the Space Shuttle plans we have just sent to Congress, and with the realistic approach to using space that we have worked out for the decade of the Seventies. Here are the main characteristics of our national space program for this decade as I see them now:

One. We have an economy-minded approach. The President has recommended a stabilized budget for NASA over the next several years of three plus billion dollars. We have adjusted our plans accordingly, and I believe we can make steady progress in all major areas of space activity with this level of funding.

Two. We have a businesslike approach. By that I mean we are seeking to increase the practical benefits from space use and to lower the cost. The Space Shuttle is the key to success in this area. We will also improve the technology of our applications satellites -- or our "working satellites" as I call them.

Three. Our space program for the Seventies is mainly Earth-oriented. We will fly the last two Apollo missions this year, and then not go back to the Moon in this decade.

Four. We have considered the arguments against using men in space, and we have rejected them. Posting space as off limits to Americans for economy reasons would have been short-sighted and dangerous. I believe we will settle this crucial issue once and for all with a favorable decision on the Shuttle in Congress this year.

Five. Despite our limited budget and our emphasis on the Shuttle, we still have a well-balanced, well-rounded space program. We will use large observatories in Earth orbit to explore the universe, we will land instruments on Mars in 1976, and we will begin exploration of Jupiter with the launch of a Pioneer spacecraft late this month.



Six. We have a program for the Seventies that encourages and facilitates international cooperation. In the Sixties we sought to bolster our sagging prestige after Sputnik by getting clearly out in front again; and we accomplished that. In this decade we believe we can best demonstrate our leadership and enhance our international prestige by working closely with other nations for mutual benefits from space.

This is an important element in the President's foreign policy. During my recent visit to the Western White House at San Clemente the President instructed me to do everything possible to encourage multinational cooperation in space. Within the next few years we hope to carry out joint programs with the Soviet Union, such as docking an Apollo spacecraft with their Salyut space station. We have made substantial progress already in discussing the technical problems involved. We are prepared to proceed to the flight stage if they are.

We have also invited West European countries and others to join us in building the Space Shuttle. Moreover, when the Shuttle is ready for operations, I am sure that many other countries and international agencies will want to make use of it. We may even be able to consider its use as a kind of high technology export to help improve our balance of trade.

I have one additional point to make regarding international cooperation in space. This aspect of our foreign policy has to be backed up by a strong space program on our part. We have to make steady progress to encourage other nations to join us in cooperative efforts. For example, I don't believe we can make much progress toward space cooperation with the Soviet Union, or get much mileage out of it, if we fall to the level of a second-rate space power.

If you saw the full text of the President's statement at San Clemente on the Space Shuttle, you will know that he closed with the thought that man's epic voyage into space is "a voyage the United States of America has led and still shall lead."

The Space Shuttle is our main bid in this decade to maintain our space leadership. We gained this leadership with a mighty surge of effort in the Apollo program. We hope to keep it with superior systems analysis and management and industrial know-how in the Shuttle program. We must also observe developments in the Russian space effort very carefully, for they seem to be devoting at least 50 percent more effort to space activities than we are, and three times as great a percentage of their Gross National Product.

In conclusion, I heartily recommend to you this carefully-defined new space program for the Seventies and the major investment it calls for in the Space Shuttle. It is a program tailored to the times; it is a worthy challenge for this progress-minded people; it is in line with our traditions as a pioneering Nation.

When the chance came to bind this Nation together with the transcontinental railroad we didn't say No because we already had the Pony Express. Let's not say No to the Shuttle just because we have old technology rockets on hand that served our needs in the last decade. Let's say Yes to the Shuttle because it is, as the President put it, "the right next step for America to take", because it is America's best bid -- America's only bid -- for a place on the space frontier in this decade.

I thank you.

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